Results of germination of winter wheat, oats and mung bean using new energized fertilizer (GVG)

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Abstract. A laboratory experiment was carried out to study the effect of a new complex energized fertilizer (GVG) based on natural raw materials - alkaline salts of naphthenic acids on germination and germination energy, seeds of winter wheat (Triticum aestivum) of Tanya variety, oats (Avena sativa L.) of Valdin765 variety and legume mung bean (Vigna radiata) of Tajiksky 1 variety. On the seventh day of germination of winter wheat in the experimental variant, the length of the seedlings exceeded the control variant by 28.0%. In oats, the length of sprouts in the experimental variant is 23.6% longer than in the control variant. In the experimental group, mung bean sprouts were 13.4% longer than the control. Due to the fact that the new energized fertilizers (GVG) include a large number of microelements necessary for the full development of plants (Na, Cu, Mg, Ca, Zn, Al, Si, Ti, Pb, Sn, Cr, Mn, Fe, Co, Ni), seeds of these crops treated with GVG solution showed better results compared to the control. This study allows us to assert that it is advisable to use the new energized fertilizer in production in the pre-sowing treatment of seeds of various crops in order to increase their yield.

1 Introduction

It is known that every year the condition of arable land in Russia is deteriorating, which is due to the fact that with the harvest more nutrients are removed from the soil than are added with fertilizers. Every year more and more soils become degraded and susceptible to erosion. In Russia, less than half of the crop area is fertilized and less than 50 kg per 1 hectare is applied, which is 4-5 times less than in Western Europe. Stabilization of the humus reserve in the soil is determined by the supply of organic substances to it. In conditions of agricultural land use, a large role is given to organic fertilizers [1-3].

In 2019, the study of this topical issue made it possible for scientists from the Kuban State Agrarian University named after I.T. Trubilin to patent a new energized substance GVG, which allows farmers to partially or completely solve it. The invention relates to the

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field of plant growth stimulants used in agriculture. The organic growth substance contains sodium salt of naphthenic acid - 35-45 wt.% rapeseed oil - 0.005-0.015 wt.% and fresh water - the rest. Organic growth substance is obtained by dissolving the sodium salt of naphthenic acid in fresh water at a temperature of 20° - 24°C with the addition of rapeseed oil to obtain a mixture. The proposed organic growth substance is used for treating crops by soaking seeds, spraying plants, and also for treating crop areas. An aqueous solution of sodium salts of naphthenic acids can be used together with fungicides when chemically treating plants. The proposed growth substance has a pronounced growth-stimulating activity of various crops [4-6].

It is believed that the best effect can be obtained by soaking the seed for 2-5 days in an aqueous solution of organic growth substance in a concentration of 0.01 to 0.05 wt.% or distributing the aqueous solution on the soil intended for sowing or with plants with a consumption of 50-100 ml of solution per 1 ha. New organic growth substance can be used by adding it to the soil in the pre-sowing period, or by spraying plants during the growing season and flowering, etc. The GVG preparation (Grivlag) has a complex stimulating effect on plants, increases productivity, crop quality and resistance to lodging [7-8].

Externally, GVG (Grivlag) is a reddish-brown colloidal liquid with a specific odor. The preparation has a significantly higher density than water, and therefore requires the creation of a stock solution before adding it to the spray material. This feature must be taken into account when using GVG (Grivlag) in agricultural production.

Back in 1960-1975. important work on new growth-stimulating organic substances was carried out under the leadership of academician M.I. Kabachnik, G.P. Kugatova-Shemyakina, V.A. Rudenko, G.P. Smirnova et al. Laboratory and field tests of new growth-stimulating substances were conducted. Despite the fact that most of them exhibit a growth-stimulating effect in various testing methods, high stimulating activity is very selective and sometimes a small change in the structure of the molecule leads to virtually the destruction of biological activity in relation to one crop, and at the same time to an increase in activity in relation to another [2, 9-10].

The raw materials for obtaining the growth substance were petroleum products from the Krasnodar Oil Refinery (Krasnodar), as well as from the Baku Oil Refinery (Baku). Naphthenic acid salts can be extracted from petroleum products by the action of an aqueous solution of sodium hydroxide (KOH).

This study was conducted on crops typical for cultivation in the Krasnodar Territory - winter wheat and oats, as well as on an atypical legume crop for this area – mung bean.

Winter wheat (Triticum aestivum) of Tanya variety is one of the most common durum semi-dwarf varieties in the Kuban, highly resistant to lodging, early ripening, heads and ripens at the same time. The originator is the Krasnodar Research Institute of Agriculture named after P.P. Lukyanenko. The variety was submitted for testing in 2001. The shape of the ear is from cylindrical to pyramidal, of medium length and density. Resistant to shedding, glumes are ovoid, width 3.5-4.5 mm, length 8-9 mm. The shoulder is medium and straight. The keel is moderately expressed. The grain is large, ovoid in shape. Weight of 1000 grains is 45.4-46.5 grams. It is a valuable wheat. The variety is highly resistant to yellow rust, powdery mildew, and loose smut [3, 11-12].

Spring oats (Avena sativa L.) variety of Valdin 765 is bred at the Kuban experimental station VIR (author D.F. Tantsyura). The variety is early ripening (from germination to commercial ripeness 83-97 days). The shape of the bush is upright. The stem is short, 86-100 cm, less often up to 125 cm. Medium thickness, hollow, strong. The grain is large, semi-long, bright yellow, valuable for its cereal qualities. The weight of 1000 grains is 27-38 g, the grain content is 434-524 g/l, ensuring consistently high grain yields. In the conditions of the Krasnodar region, the yield reaches 72 c/ha. It differs from cultivated varieties in its resistance to lodging, bacterial spot, crown rust, loose and closed smut [2, 4].

Mung bean (golden bean) (Vigna radiata) variety Tajik 1 is annual herbaceous plant; species of the genus Vigna of the Legume family; leguminous crop originating from India. Mung bean seeds are actively used as food in many countries. In recent years, there has been interest in this culture in Slavic countries, primarily as a dietary food product with a high content of complete protein, vitamins and minerals. Proponents of a healthy diet also appreciate mung bean because it does not contain substances harmful to the human body that are present in soybeans and some types of beans. The Tajik 1 variety is Central Asian, bred in the Soviet Union, is little affected by diseases, has relatively large seeds and a relatively high yield (25 c/ha) [3, 5]

2 Material and methods

The objective of this study was to establish a stable positive effect by germinating seeds of winter wheat, oats and mung bean in Petri dishes when treated with a new energized substance GVG and without treatment, to determine the difference in the intensity of the energy of seed germination of these plants (3rd day) and germination (7th day). Research on the effectiveness of GVG was carried out in laboratory conditions at the Krasnodar research Centre for Animal Husbandry and Veterinary Medicine, Krasnodar, Znamensky village. Sprouting was carried out in Petri dishes at an ambient temperature of 20-22°C, by uniformly soaking 100 plant seeds with a certain amount (50 ml) of a solution of the required concentration (0.01 ml GVG per 1 liter of water) for 8 hours. After 8 hours of soaking, the seeds were evenly laid out in Petri dishes and soaked in the control with distilled water and in the experiment with a solution of a new energized fertilizer in a volume of about 5 ml (until the paper is completely wetted). Each bowl contained 100 seeds of the crops under study. On the third day of the study, the energy of germination and the length of the emerging seedlings were determined. On the seventh day, germination was determined, at which both sprouts and roots appeared in cereal crops (oats, wheat), and only roots in the legume mung bean crop. Each sprout and root were measured, and the data was entered into calculation tables. All data were statistically processed. The research scheme for seed sprouting of the studied crops in Petri dishes is presented in Table 1.

Table 1. Seed sprouting in Petri dishes.

Name of solutions	**Stage**	
Water	Determination of seed sprouting energy (on the 3rd day)	Determination of seed germination (on the 7th day)
New energized fertilizer GVG		

The object of this research is the seeds of three farm crops, often grown both in Russia and in the world (wheat, oats, mung bean) and their responsiveness to the new energized fertilizer GVG (Grivlag) for subsequent recommendations for its use.

3 Results

According to Table 2, it can be judged that there is a significant increase in the energy of seed germination when treated with GVG.

Table 2. Length of sprouts, % (on the 3rd day) according to GOST 12038-84.

Name of solutions (0.01/1 l)	**Types of farm crop seeds**		
	Length of sprouts (average per 100 pcs.), mm		
	Winter wheat	**Spring oats**	**Mung bean**
Control (water)	8.14±0.3	1.6±0.15	20.65±0.33
Experi-ment (new energized fertilizer GVG)	9.56±0.37**	2.09±0.15**	25.64±0.39***

Note: *** - $p<0.001$

The degree of reliability in the data for wheat and oats is moderate. The data obtained in the mung bean version have a high degree of reliability. Germination energy is the ability of seeds to germinate quickly and uniformly. Since all the studied crops began to sprout on the third day, they were measured and the results were compared. Per 100 sprouted seeds of winter wheat, the length of the seedlings in the experimental variant is 17.4% greater (9.56 mm) than in the control (8.14 mm). Spring oat seeds in the experimental variant (2.09 mm) had a sprout length that was 30.6% longer than the control (1.6 mm). The mung bean seeds in the experiment had an average length of 25.64 mm and exceeded the length of the sprouts in the control variant (20.65 mm) by 24.2%.

The tested seed material was weighed. Data on the weight of the studied seeds on the third day of germination are shown in Table 3.

Table 3. Weight of 100 seeds on the third day of germination, g.

Variant	Types of farm crop seeds		
	Weight of 100 seeds, g		
	Winter wheat	Spring oats	Mung beans
Control (dry control)	3.90	2.80	5.75
Control (water)	5.80	3.10	15.70
Experiment (new energized fertilizer GVG)	6.30	3.25	15.85

The data presented indicate that the weight of germinated seeds is always significantly higher due to absorbed moisture and germination rate. However, the weight of 100 sprouted seeds in the experimental version is slightly higher than the control - seeds sprouted in distilled water. In particular, wheat seeds sprouted with GVG by 61.5% (6.30 g) exceed the weight of the dry control (non-sprouted seeds 3.90 g), and seeds sprouted in water (control) by only 48.7% (5 ,80 g). Accordingly, seeds germinated with GVG were 12.8% higher than the weight of seeds germinated with water. In studies of oats, the following results were obtained: grains sprouted in a GVG solution exceeded the dry control (2.8 g) by 16.1% (3.25 g), grains sprouted in distilled water - by 10.7% (3. 1 g), and if we compare both germinated variants, then the experimental one (GVG) is 5.4% larger in weight than the control one. The weight of 100 mung bean seeds germinated in GVG exceeded the dry control (5.75 g) by 175.6% (15.85 g), and those germinated with water (control) - by 173% (15.70 g). Sprouted mung bean in the experimental version has a weight greater than that sprouted in water by 2.6%.

Laboratory germination of seeds is determined on the seventh day of sprouting. During this period, cereal crops (wheat, oats) already have roots and a stem sprout; in the bean crop mung bean, only the sprout increases; the division into root and stem does not yet occur. The results of determining the length of sprouts on the seventh day of the study of crops are presented in Table 4.

Table 4. Length of sprouts, % (on the 7th day) according to GOST 12038-84, n=3.

Name of solutions (0.01/1 l)	Types of farm crop seeds		
	Length of sprouts (average per 100 pcs.), mm		
	Winter wheat	Spring oats	Mung beans
Control (water)	9.42±0.25	18.47±0.23	26.77±0.2
Experiment (new energized fertilizer GVG)	12.06±0.31***	22.82±0.24***	30.35±0.26***

Note: *** - $p<0.001$

All studies showed the highest degree of reliability. Table 4 displays the length of the sprouts that appeared on the seventh day of the research. In winter wheat in the experimental variant, the average length of seedlings (12.6 mm) exceeded the control (9.42 mm) variant by 28.0%. In oats, the length of sprouts on the seventh day in the experimental

variant was 22.82 mm, which is 23.6% longer than in the control variant (18.47 mm). Mung beans in the experimental group had an average sprout length of 30.35 mm, which is 13.4% greater than the average length of the control - 26.77 mm.

For winter wheat and spring oats, roots were measured on the seventh day (Table 5).

Table 5. Root length, % (on the 7th day) according to GOST 12038-84, n=3

Name of solutions (0.01/1 l)	Types of farm crop seeds	
	Length of roots (average per 100 pcs.), mm	
	Winter wheat	Spring oats
Control (water)	5.66±0.1	8.25±0.26
Experi-ment (new energized fertilizer GVG)	7.48±0.13***	10.65±0.28***

Note: *** - p<0.001

The data presented in Table 5 have a high degree of reliability. The average length of wheat roots on the seventh day of germination in the experimental variant exceeded the control by 32.2% and amounted to 7.48 mm. The length of the roots in the control variant was 5.66 mm. For spring oat seeds, the average root length in the experimental variant exceeded the control by 29.1% and amounted to 10.65 mm. In the control variant, the average length of the oat root was 8.25 mm.

4 Discussions

Based on the persistent, positive effect of using a solution of a new energized fertilizer when germinating winter wheat, spring oats and mung bean, as well as on the basis of previous experiments, it can be argued that GVG (Grivlag) is a fertilizer (growth substance) capable of increasing the productivity of farm crops in the field. The results obtained in our studies correspond to previously conducted foreign studies [4, 9]

5 Conclusions

Based on the results obtained during the research, a number of conclusions can be noted regarding the positive effect of the new energized fertilizer GVG (Grivlag) on the farm crop seeds as a result of their germination in laboratory conditions.

- For 100 viable seeds of winter wheat on the third day of germination, the length of the seedlings in the experimental variant is 17.4% greater than in the control. The spring oat seeds in the experimental variant had a sprout length that was 30.6% longer than the control; mung bean seeds in the experiment exceeded the sprout length by 24.2% compared to the control.
- Wheat seeds germinated with GVG were 12.8% higher than the weight of seeds germinated with water. In studies of oats, the following results were obtained: grains sprouted in a GVG solution exceeded the weight of grains sprouted in water by 5.4%. Sprouted mung bean in the experimental version has a weight greater than that sprouted in water by 2.6%.
- On the seventh day of germination of winter wheat in the experimental variant, the length of the seedlings exceeded the control variant by 28.0%. In oats, the length of sprouts in the experimental variant is 23.6% longer than in the control variant. In the experimental group, mung bean sprouts were 13.4% longer than the control.
- The average length of wheat roots on the seventh day of germination in the experimental variant exceeded the control by 32.2%. For oat seeds, the average root length in the experimental variant exceeded the control by 29.1%.

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